

REMARKS

Applicant thanks the Examiner for his consideration and allowance of claims 5-30.

Specification Amendments

The paragraph beginning at page 22, line 7 has been amended to change "Figure 43" to "Figure 87." This amendment has been made to address the Examiner's objection to Figure 43. Other typographical issues in the paragraph are also corrected.

The paragraph beginning at page 26, line 10 has been amended to address typographical issues.

The specification has been amended at page 45, line 18, page 46, lines 15 and 21, and page 46, line 22 to change "plate 146" to "plate 240." This amendment has been made to address the Examiner's objections to Figures 21 - 23.

The paragraphs beginning at page 46, line 15 and 22 have been amended to correct typographical issues.

The paragraph beginning at page 47, line 18 has been amended to include reference information requested by the Examiner and to correct other typographical issues.

The paragraph beginning at page 47, line 33 has been amended to change "side walls 252" to "side walls 250." This amendment has been made to address the Examiner's objection to Figure 25. Applicant notes that this paragraph has also been amended to correct other typographical issues.

The paragraph beginning at page 56, line 35 has been amended to correct typographical issues.

The paragraph beginning at page 57, line 6 has been amended to address typographical issues.

The paragraph beginning at page 85, line 21 has been amended to include reference information requested by the Examiner and to correct other typographical issues.

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Drawing Amendments

Figures 26, 41, 55, and 58 have been amended. All drawing amendments are shown in red ink.

Regarding the Examiner's objection to Figure 11 for including reference numerals not otherwise used in the specification, Applicant notes that reference material 188, shown in figure 11, is discussed on pages 69 and 70. See specifically page 69 at line 30 and page 70 at line 4. Applicant also notes that detection device 461, shown in figure 11, is discussed on page 71 at line 10 among other places. Also, reference material 458, shown in figure 11, is discussed on page 82 at line 12 among other places.

Figure 26 has been amended to include reference numeral 265. Support for this amendment exists in the application as originally filed. See, for example, page 50, line 9 among other places.

Figure 54 has been amended to include reference numeral 494. Support for this amendment exists in the application as originally filed. See, for example, page 83, line 28 among other places.

Figure 58 has been amended to change "500, 501, or 502," to "500 or 501," and to change "463, 464, or 465," to "463 or 464." Support for this amendment exists in the application as originally filed. See, for example, page 90, lines 20 and 34, among other places.

Title Amendment

The title of the application has been amended as requested by the Examiner.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

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PATENT

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title of the application has been amended as follows: SCANNING PROBE MICROSCOPY INSPECTION AND MODIFICATION SYSTEM [OBJECT INSPECTION AND/OR MODIFICATION SYSTEM AND METHOD]

IN THE SPECIFICATION:

The paragraph beginning at page 22, line 7 has been amended as follows: Then, referring to Figure 9, the controller 114 controls the positioning system 103 to scan the activated tip 138 over the reference SPM probe 133. The other components 123 of the SPM system 100 further include a particle measurement control circuit 187, as shown in Figure 87 [43]. The controller controls the particle measurement control circuit to cause the SPM probe to produce an e-beam [that] and detect any secondary electrons in the manner discussed later for the e-beam tool 382 of the SPM probe 122-8. The particle measurement control circuit makes a particle measurement of the detected electrons and provides it to the controller. The controller collects the particle measurements and produces an image of the activated tip in the same manner as a conventional particle microscope, such as an electron microscope. From the produced image, the positional offset of the tip at the known position of the SPM probe can be determined. Based on this positional offset, the precise positioning of the tip with respect to the reference location is then calibrated. Moreover, from the produced image, it can be determined whether or not the tip is defective.

The paragraph beginning at page 26, line 10 has been amended as follows:

Referring to Figure 11 [10] again, the second calibration structure 128-2 also includes one or more other reference structures 191 that may be used to calibrate the position of the activated tip 138. These reference structures are formed on an insulating material 199 on the base 190 of the calibration structure. The reference structures may each comprise a conductive tip at a precisely known position with respect to the reference location. Each conductive tip is coated with a conductive material with known conductive properties and is connected to an STM

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measurement circuit 213. The STM measurement circuit is one of the other components 123 of the SPM system 100.

The paragraph beginning at page 45, line 17 has been amended as follows:

Specifically, the SPM probe 122-1 is formed so that the target surface 150 of each tip 138 of the probe on which the obdurate plate **[146] 240** is formed is oriented with respect to a particular crystal axis (or direction) 152 of the core material 144 with a desired orientations angle. Then, the obdurate plate comprises a crystal that **[comprise the obdurate plate]** is grown on the target surface of each tip with the crystal growth (or deposition) vector 154 being oriented with respect to the crystal axis of the core material with a desired crystal growth angle. Moreover, during crystal growth of the obdurate plate, a desired bias voltage can be applied to the core material to create an electrical field. By positioning the target surface in the bias electric field and/or a bias magnetic field in different ways about the axis of the crystal growth vector, different orientations (or alignments) of the grown crystal on the target surface can be formed, as shown in Figures 22 and 33. Thus, the orientations and crystal growth angles, the bias voltage, and the position of the target surface about the axis of the crystal growth vector, can be selected to produce a tip with an obdurate plate that has a desired crystal orientation on the target surface. And, it may be made conductive in the same way as was described earlier for the obdurate coating 146 so that it can be used with the STM measurement circuit 213 to make STM measurements.

The paragraph beginning at page 46, line 15 has been amended as follows:

Similarly, the obdurate plate 250 **[146]** may be formed with a silicon carbide or carbon nitride crystal that has a desired crystal orientation on the target surface 150. In order to do so, the process described earlier for growth of silicon carbide and carbon nitride crystals in forming the obdurate coating 146 would be modified. This would be done in the same way that the earlier described process of growing diamond crystals to form the obdurate coating was modified to grow the diamond crystal that forms the obdurate plate 250 **[146]**.

The paragraph beginning at page 46, line 22 has been amended as follows:

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The obdurate plate 250 [146] was just described as being a single crystal grown on the target surface 150 of the core material 144. However, those skilled in the art will recognize that the obdurate plate could be formed by one or more crystals that are grown on the target surface. In this case, the application of the bias voltage to the core material would cause these crystals to be symmetrically aligned.

The paragraph beginning at page 47, line 36 has been amended as follows:

The tip 242 of each SPM tool 239 of the SPM probe 122-3 includes a tapered core material 144 and a multiwalled nanotube (i.e., nanostructured tube) 244. The nanotube may comprise carbon or boron nitride and be formed in the manner described in S. Iijima, "Helical Microtubules of Graphitic Carbon," ["_____"], Nature (London) 354, 56 (1991) and A. Loiseau et al., "Boron Nitride Nanotubes with Reduced Number of Layers Synthesized [Synthesized] by Arc Discharge," Physical Review Letters, vol. 76, no. 25 (June 1996), pp. 4737-4740, and Nasreen G. Chopra et al., "Boron Nitride Nanotubes," which are hereby explicitly incorporated by reference. Moreover, in the manner described in Hongjie Dai et al., "Nanotubes as Nanoprobes in Scanning Probe Microscopy," Nature, vol. 334 (November 1996), pp. 147-150, which is also hereby explicitly incorporated by reference[, the]. The nanotube is attached to the core material for use in making SPM measurements by bonding it to the core material. And, as described in this reference, the narrow diameter (e.g., 5-20 nanometers) of the nanotube enables it to provide sub nanometer resolution. And, its flexibility allows it to bend back into its original shape and position in case of inadvertent crashes in the object 102 or one of the calibration structures 128.

The paragraph beginning at page 47, line 33 and ending at page 48, line 10 has been amended as follows:

Turning to Figures 25, the tip 242 of each SPM tool 239 includes one or more crystals of an obdurate coating 246 on the nanotube 244. Since the ends of the nanotube 244 are closed when formed, as described in "Boron Nitride Nanotubes with Reduced Number of Layers Synthesized [Synthesized] by Arc Discharge" just referenced, crystal of the obdurate material can be formed on the closed surface 248 at the free (or unattached) end of the nanotube.

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Moreover, crystals of the obdurate material may also be grown at the free end on the side walls 250 of the nanotube. As with the probes 122-1 and 122-2, the obdurate coating may comprise diamond, silicon carbide, carbon nitride, diamond like carbon, or some other suitable obdurate material and may be formed the ways described earlier. Thus, as shown in Figure 25, the obdurate coating could comprise a plate on the closed surface 248 and plates on the side walls 250 [252] that are formed with a desired crystal orientation in the manner described earlier for the obdurate plate of each tip 238 of the second probe. And, these plates may be made conductive in the same way as was described earlier for the obdurate coating 146 so that it can be used with the STM measurement circuit 123-11 to make STM measurements.

The paragraph beginning at page 56, line 12 has been amended as follows:

The particle removal structure 342 includes an inlet (i.e., input port) 332 [337] on the upper surface 140 on the fifth SPM probe 122-5, a duct 340 formed in the base 130 of the probe, and an outer annular outlet (i.e., output port) 336 on the lower surface 142 of the probe, as shown in Figures 27 and 35. The duct connects the inlet and the outer annular outlet so that they are in fluid communication with each other. As shown in Figure 86, the surface 142 of the base of the SPM probe 122-5 has steps 830 in it.

The paragraph beginning at page 56, line 24 has been amended as follows:

Similarly, as shown in Figures 27 and 35, the particle removal structure 342 includes an inlet 330 on the upper surface 140 of the fifth SPM probe 122-5, a duct 341 formed in the base 130 of the probe, and an inner annular outlet 335 on the lower surface 142 of the probe. The duct connects the inlet and the annular inner outlet so that they are in fluid communication with each other.

The paragraph beginning at page 56, line 35 has been amended as follows:

The inner annular outlet 335 is at a step 831 [832] lower than the step 830 at which the aperture opens out at. The low viscosity gas serves as seal to prevent the high viscosity gas discussed from entering the microvacuum chamber created in the gap between the step 831 and the surface 166 of the object 102. This microvacuum chamber is created in the

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manner discussed earlier for SPM probe 122-1. Moreover, a differential pressure chamber is created in the gap between the step 830 and the surface of the object. This is created in the same way as the microvacuum chamber just mentioned except that the high viscosity gas is introduced rather than a vacuum.

The paragraph beginning at page 57, line 6 has been amended as follows:

Additionally, the particle removal structure 342 includes an outlet 331 on the upper surface 140 of the fifth SPM probe 122-5, a duct 339 formed in the base 130 of the probe, and a middle annular inlet 337 on the lower surface 142 of the probe, as shown in Figures 27 and 35. The duct connects the outlet and the annular middle inlet so that they are in fluid communication with each other.

The paragraph beginning at page 85, line 21 has been amended as follows:

For example, it may be desired to deposit diamond like carbon on the object 102 to make the object harder. In this case, the fluid could be argon, the material of the cathode 487 would be carbon, and the other components 123 of the SPM system 100 would include a magnetic field source to create a magnetic field for deposition of the diamond like carbon. This may be done in the manner and under the conditions discussed in "Multilayer Hard Carbon Films with Low Wear Rates," by Joel W. Ager et. al., Surface and Coatings Technology, vol. 91, pp. 91-94, May 1997 [_____], "Properties of Vacuum Arc Deposited Amorphous Hard Carbon Films," by Simone Anders et al., Applications of Diamond Films and Related Materials: The Third International Conference, pp. 809-812, 1995, "Hardness, Elastic Modulus, and Structure of Very Hard Carbon Films Produced by Cathodic-Arc Deposition with Substrate Pulse Biasing," by George M. Pharr et al., Applied Phys. Lett., vol. 68 (6), pp 779-781, Feb. 5, 1996, and "Development of Hard Carbon Coatings for Thin-Film Tape Heads," by Bharat Bhushan and B.K. Gupta, IEEE Trans. Magn., vol. 31, 2976-2978, 1995, which are all hereby incorporated by reference. Specifically, this may be done with multiple layers of the diamond like carbon to increase the overall strength of the deposited material.

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